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Using ELBE To Build Debian Based Embedded Systems

Embedded Linux Conference Europe - Berlin, Germany

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Agenda

1. Why should I use Debian / ELBE
2. ELBE Features
3. Example: Beaglebone Black SDCard Image
4. Own Software with ELBE pbuilder
5. Customize Image


BUILD
YOUR OWN
LINUX
DISTRO


HURLIMANN O.AGERI

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it might be harder than you think

YOU

- need to wait until every package and its dependencies are compiled
- are probably the only one testing the resulting binaries
- are alone with the bugs in your binary packages
- need to track security of your distro

...why not let OTHERS do the job and focus on your application?

Who are the OTHERS?

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Why Debian based?

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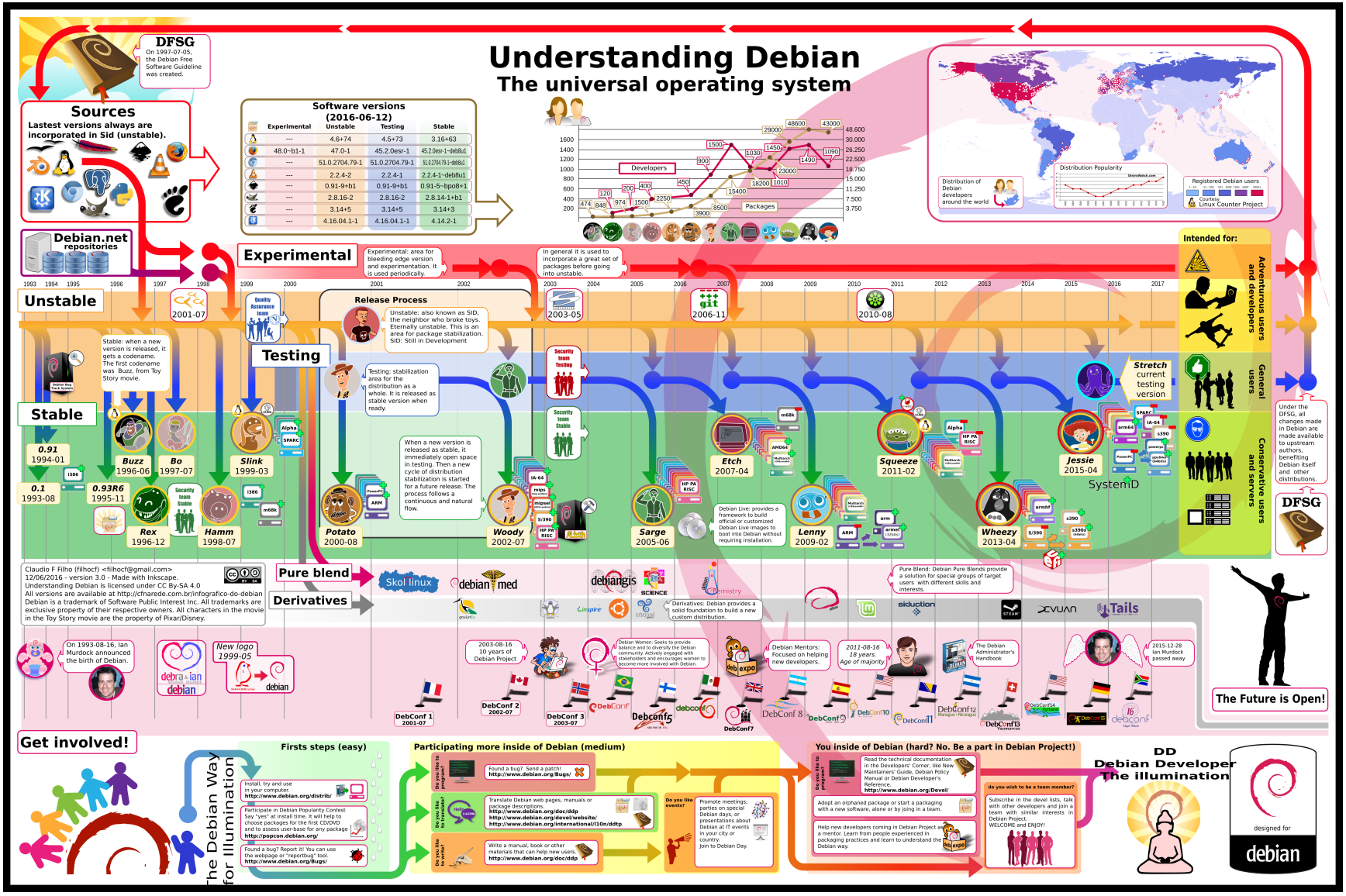
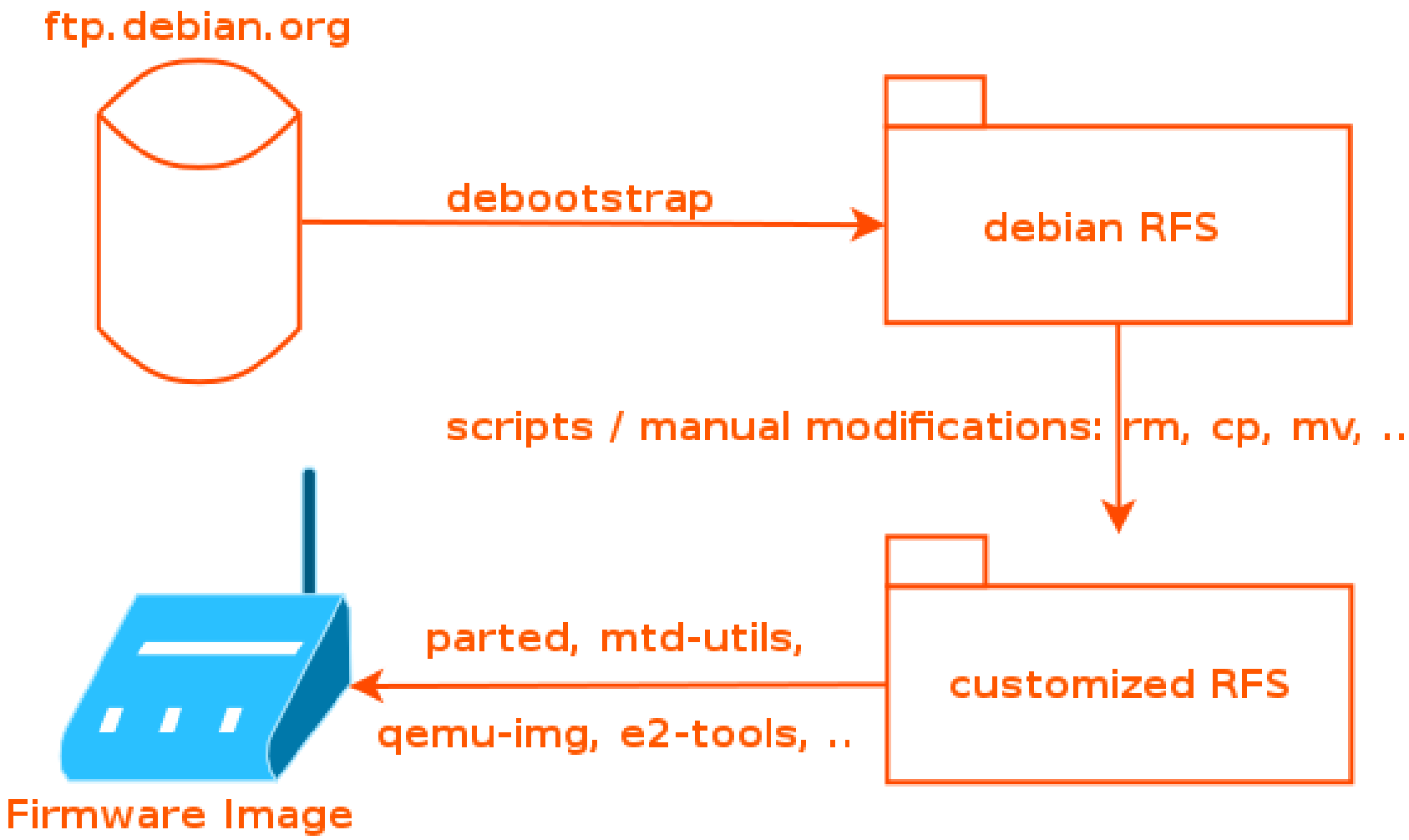


Why elbe?


ftp.debian.org
debootstrap
debian RFS
scripts / manual modifications: rm, cp, mv, ..
parted, mtd-utils,
qemu-img, e2-tools, ..
customized RFS
Firmware Image

Why elbe?

Why elbe?

Why elbe?

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elbe is just python code that uses Debian infrastructure and tools

ELBE Highlights

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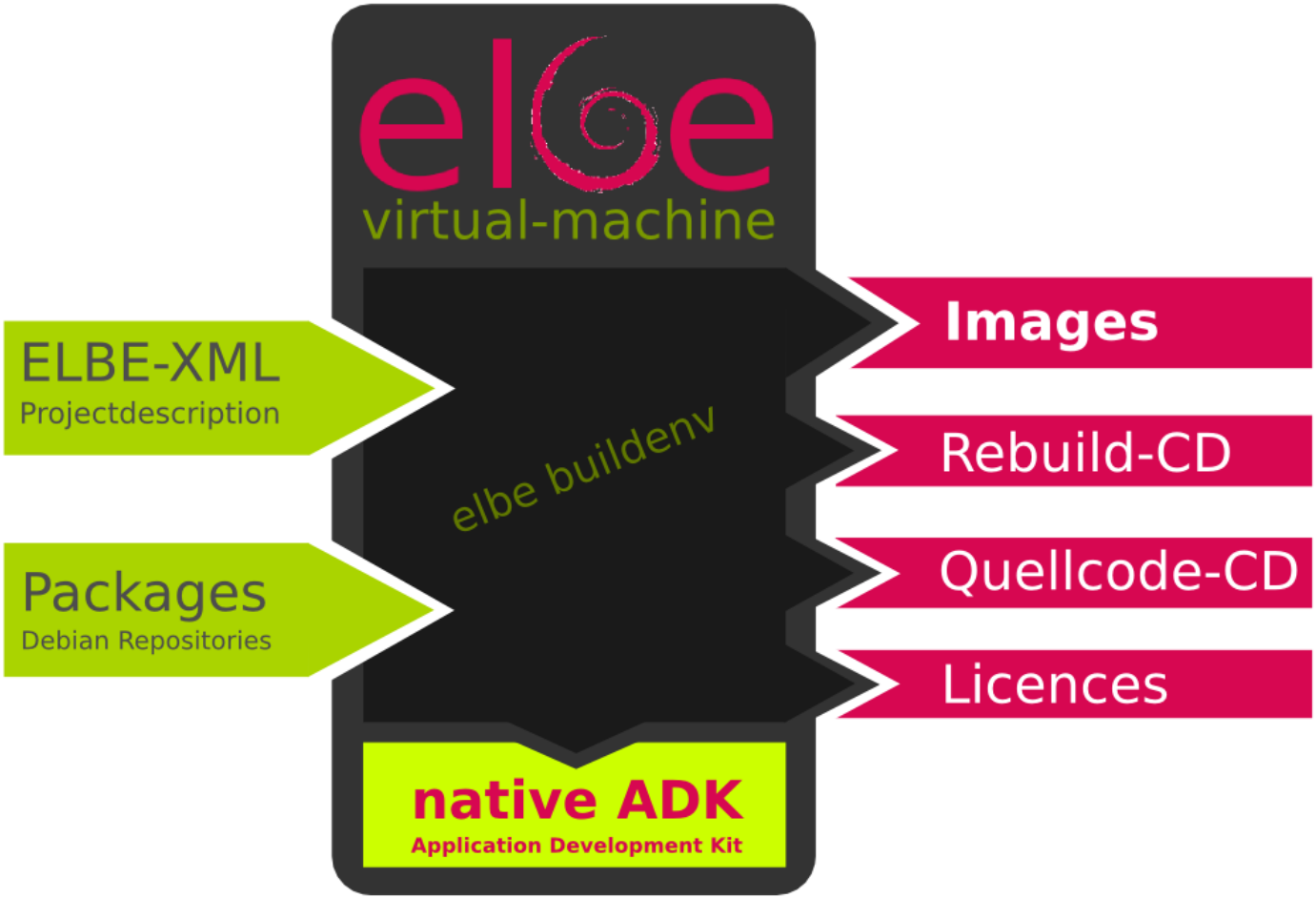
- Project description is in a single XML file
- Integrate Debian binary packages
- Build own software components
- Customize default config files
- Produce flashable images
- Regenerate images and build environment

ELBE Highlights



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ELBE stable

The current elbe stable release is elbe 1.1

- target images for armel, armhf, i386, amd64 and powerpc

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- CDROM with all used Debian source packages

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- licence.txt with all LICENCES used on the target

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- target related sysroots for cross-compile toolchains
- CDROM with all used Debian source packages
- CDROM with all used Debian binary packages (target and initvm)
- licence.txt with all LICENCES used on the target
- check for updates of a generated target

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- CDROM with all used Debian source packages
- CDROM with all used Debian binary packages (target and initvm)
- licence.txt with all LICENCES used on the target
- check for updates of a generated target
- different modes to shrink the target image

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ELBE testing

The next major release will be elbe 2.0

The current testing releases are called elbe 1.9.x

New features in 'testing':

- elbe-pbuilder for building own debian packages

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- display build log, instead of 'wait project is busy'
- generate SPDX files
- extended partitions support for msdoshd

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Install Debian packages

ELBE stable

```
$ echo "deb http://debian.linutronix.de/elbe jessie main" > \
/etc/apt/sources.list.d/elbe.list
```

ELBE testing

```
$ echo "deb http://debian.linutronix.de/elbe-testing jessie main" > \
/etc/apt/sources.list.d/elbe-testing.list
```

common for testing and stable

```
$ apt-get update
[...]
$ apt-get install elbe
[...]
```

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create an initvm

```
$ elbe initvm create --directory $HOME/elbe-initvm
```

the initvm is

- a minimal Debian installation including 'elbe-daemon'
- used to build the embedded target (firmware) images
- reproducable by using 'bin-cdrom.iso'
  this iso is generated with each target image build
- not started after reboot
  (use 'elbe initvm start –directory $HOME/elbe-initvm')

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simple XML for beaglebone black 1/4

```
<ns0:RootFileSystem
      xmlns:ns0="https://www.linutronix.de/projects/Elbe"
      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      created="2016-09-29T18:29:33"
      revision="6"
      xsi:schemaLocation="https://www.linutronix.de/projects/Elbe dbsfed.xsd">
  <project>
    <name>beaglebone-black-simple</name>
    <version>1.0</version>
    <description>debian jessie rootfs for beaglebone black</description>
    <buildtype>armhf</buildtype>
    <mirror>
      <primary_host>ftp.de.debian.org</primary_host>
      <primary_path>/debian</primary_path>
      <primary_proto>http</primary_proto>
    </mirror>
    <suite>jessie</suite>
  </project>
```

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simple XML for beaglebone black 2/4

```
<target>
  <hostname>lxbbbsimple</hostname>
  <domain>linutronix.de</domain>
  <passwd>foo</passwd>
  <console>ttyO0,115200</console>
  <images>
    <msdoshd>
      <name>sdcard.img</name>
      <size>1500MiB</size>
        <partition>
          <size>50MiB</size> <label>boot</label> <bootable />
        </partition>
        <partition>
          <size>remain</size> <label>rfs</label>
        </partition>
    </msdoshd>
  </images>
```

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simple XML for beaglebone black 3/4

```
<fstab>
  <bylabel>
    <label>rfs</label>
    <mountpoint>/</mountpoint>
    <fs>
      <type>ext2</type>
      <tune2fs>-i 0</tune2fs>
    </fs>
  </bylabel>
  <bylabel>
    <label>boot</label>
    <mountpoint>/boot</mountpoint>
    <fs>
      <type>vfat</type>
    </fs>
  </bylabel>
</fstab>
```

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simple XML for beaglebone black 4/4

```
    <finetuning>
      <cp path="/usr/lib/linux-image-3.16.0-4-armmp/am335x-boneblack.dtb">
         /boot/dtb-3.16.0-4-armmp</cp>
      <cp path="/usr/lib/u-boot/am335x_boneblack/u-boot.img">
         /boot/u-boot.img</cp>
      <cp path="/usr/lib/u-boot/am335x_boneblack/MLO">/boot/MLO</cp>

      <command>echo "uenvcmd=setenv bootargs 'console=ttyO0,115200 root=/dev/...
                     ..." > /boot/uEnv.txt </command>
    </finetuning>
    <pkg-list>
      <pkg>u-boot-omap</pkg>
      <pkg>linux-image-3.16.0-4-armmp</pkg>
    </pkg-list>
  </target>
</ns0:RootFileSystem>
```

Build the SDCard Image

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using high-level interface:

```
$ elbe initvm submit --keep-files examples/armhf-ti-beaglebone-black-simple.xml
```

build output:

```
$ cd elbe-build*
$ ls -lh
-rw-r--r-- 1 manut lx  381M Sep 29 21:38 bin-cdrom.iso
-rw-r--r-- 1 manut lx 1014K Sep 29 21:37 elbe-report.txt
-rw-r--r-- 1 manut lx  1.3M Sep 29 21:37 licence.txt
-rw-r--r-- 1 manut lx  1.6M Sep 29 21:37 licence.xml
-rw-r--r-- 1 manut lx  863K Sep 29 21:37 log.txt
-rw-r--r-- 1 manut lx  1.5G Sep 29 21:37 sdcard.img
-rw-r--r-- 1 manut lx   73K Sep 29 21:37 source.xml
-rw-r--r-- 1 manut lx 1019M Sep 29 21:40 src-cdrom.iso
-rw-r--r-- 1 manut lx   116 Sep 29 21:37 validation.txt
```

Flash the image to a SDCard

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```
$ zcat sdcard.img.gz | sudo dd of=/dev/mmcblk0 bs=5M
```

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add users and groups

```
[..]
<finetuning>
  <addgroup>debian</addgroup>
  <adduser passwd="elbe" shell="/bin/sh" groups="users,debian">
    elbe</adduser>
```

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Add own software

```
[..]
<pbuilder>
  <git revision='a15a83e2649765736aa6bfe9c490a39a417cf69b'>
    https://github.com/Linutronix/libgpio.git
  </git>
</pbuilder>
<pkg_list>
   <pkg>libgpio1</pkg>
   [..]
```

The project needs to be in a git or svn repository and the source needs to be debianized.

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```
[..]
<pbuilder>
  <git revision='a15a83e2649765736aa6bfe9c490a39a417cf69b'>
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  </git>
</pbuilder>
<pkg_list>
   <pkg>libgpio1</pkg>
   [..]
```

The project needs to be in a git or svn repository and the source needs to be debianized.

See the excellent 'Debians new Maintainers guide' for details about debianizing your source:

https://www.debian.org/doc/devel-manuals#maint-guide

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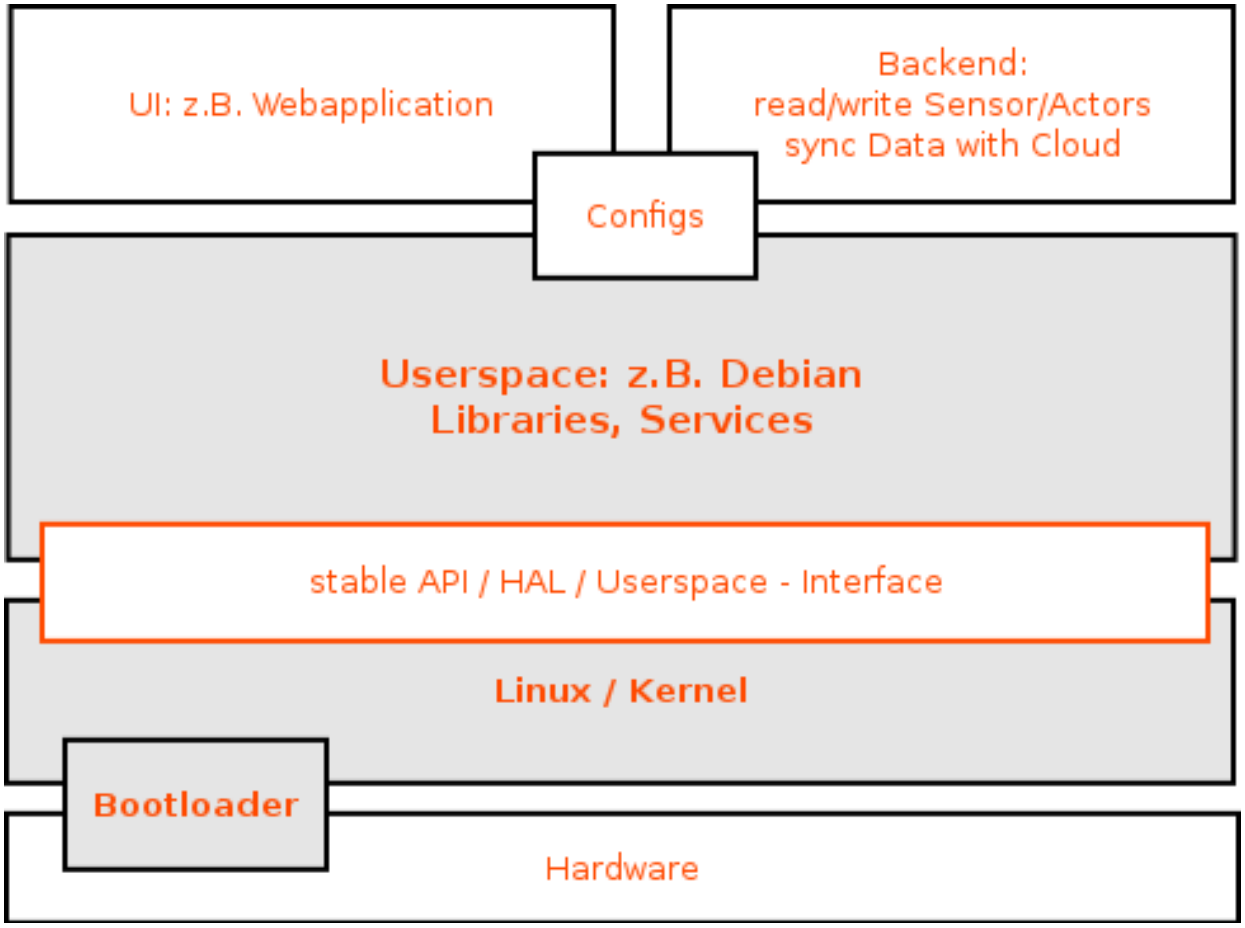
Use Debian and custom Bootloader / Kernel



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about ELBE pbuilder

- pdebuild and qemu-user is used to build the packages

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- pdebuild and qemu-user is used to build the packages
- build-dependencies need to be specified correctly

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about ELBE pbuilder

- pdebuild and qemu-user is used to build the packages
- build-dependencies need to be specified correctly
- build environment is created from the same debian mirrors / releases as the target image

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shrink image

- remove man, unneeded locales, package lists in finetuning
- set the <norecommend> tag
- use 'diet' or 'tighten' mode to generate target RFS

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copy mode basics

- the result of debootstrap + pkgs from pkg-list are in a directory called 'chroot'
- the target directory is a copy of the chroot directory
- archive extraction and finetuning runs on the target directory

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copy modes

default target is a 1:1 copy of chroot

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diet pkg-list = pkg-list +
runtime_dependency of each pkg-list entry

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diet pkg-list = pkg-list +
runtime_dependency of each pkg-list entry
file-list = get_files referenced by each pkg-list entry

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runtime_dependency of each pkg-list entry
file-list = get_files referenced by each pkg-list entry
copy file-list to target

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default target is a 1:1 copy of chroot

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runtime_dependency of each pkg-list entry
file-list = get_files referenced by each pkg-list entry
copy file-list to target

tighten same as diet but without resolving
runtime_dependencies

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Resources

elbe website	http://elbe-rfs.org
elbe source	http://github.com/linutronix/elbe

Conclusion

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- let Debian do the maintainance work
- use ELBE to integrate and build Debian binary packages
- focus on application development

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Thanks for your attention

Contact

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